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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/887,490	06/22/2001	Lior Ophir	TI-30916	7722

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EXAMINER

AHN, SAM K

ART UNIT PAPER NUMBER

2637

DATE MAILED: 10/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 09/887,490	<b>Applicant(s)</b> OPHIR ET AL.	
	<b>Examiner</b> Sam K. Ahn	<b>Art Unit</b> 2637	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 22 June 2001.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-48 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5, 12-17, 26-28, 38, 39 and 45 is/are rejected.
- 7) ☒ Claim(s) 6-11, 18-25, 29-37, 40-44 and 46-48 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 June 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>052302.090701</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Drawings*

1. Please resubmit Fig.5 as the copy available at the Office only partially illustrates the figure.

### *Claim Objections*

2. Claims 1-48 are objected to because of the following informalities:

In claim 1, line 1, delete "method of binary" and insert "method of a binary".

In claims 2,3,6,9,10,18 please define kc,ks, nc,ns,k,n in the respective claims, such as reciting "wherein ... is an integer".

In claim 4, line 2, delete "a turbo trellis coded modulator" and insert "the".

In claim 4, line 3, please define "TH-precoding".

In claim 5, line 4, delete "shell mapping and TTCM" and insert "a shell mapping and the TTCM encoder".

In claim 6, line 5, delete "the kc-tuple part" and insert "the binary kc-tuple".

In claim 6, lines 5-6, delete "turbo trellis coded modulator (TTCM)" and insert "TTCM".

In claim 6, line 7, delete "the rs-tuple part" and insert "the syndrome rs-tuple".

In claim 6, line 10, delete "part".

In claim 6, line 11, delete "rate kc/nc".

In claim 6, line 15, delete "a rate" and insert "the rate".

In claim 6, line 17, delete "part".

In claim 6, line 18, delete "rate kc/nc".

In claims 7,13, line 2, respectively, delete "a turbo decoder and constellation" and insert "a receiver turbo decoder and receiver constellation".

In claim 7, line 5, delete "the partitioned symbol sequence" and insert "the partitioned binary coded symbol sequence".

In claim 8, line 3, delete "the partitioned symbol sequence" and insert "the partitioned binary symbol sequence".

In claims 8, 9 lines 4,5, respectively, delete "the turbo" and insert "the receiver turbo".

In claim 9, lines 8-10, respectively, delete "part".

In claim 10, line 3, delete "the estimated" and insert "an estimated".

In claim 10, lines 3 and 5, delete "part".

In claim 10, line 5, delete "an estimated" and insert "the estimated".

In claims 11, 17, lines 3, respectively, delete "the estimated binary rs-tupel part" and insert "an estimated syndrome rs-tupel".

In claim 11, line 5, delete "an estimated" and insert "the estimated".

In claim 14, line 3, delete "the partitioned symbol sequence" and insert "the partitioned binary symbol sequence".

In claims 14,15, lines 4,5, respectively, delete "the turbo" and insert "the receiver turbo".

In claim 15, lines 8-10, respectively, delete "part".

In claim 16, line 3, delete "the estimated" and insert "an estimated".

In claim 16, lines 3 and 5, delete "part".

In claim 16, line 5, delete "an estimated" and insert "the estimated".

In claim 18, line 4, delete "the remaining" and insert "remaining".

In claim 18, line 10, delete "a number N of transmit symbols" and insert "N symbols".

In claim 19, line 3, delete "the turbo" and insert "the receiver turbo".

In claim 19, line 3, delete "and constellation" and insert "and receiver constellation".

In claims 19,20, lines 5 and 1,3, respectively, delete "N received symbols" and insert "N symbols".

In claim 21, line 3, delete "N received symbols" and insert "N symbols".

In claim 21, line 7, delete "the remaining" and insert "remaining".

In claim 22, line 2, delete "N transmit symbols" and insert "N symbols".

In claim 23, line 3, delete "the turbo" and insert "the receiver turbo".

In claim 23, line 3, delete "and constellation" and insert "and receiver constellation".

In claims 23,24, lines 5 and 1,3, respectively, delete "coded" and insert "precoded".

In claim 25, line 3, delete "coded" and insert "precoded".

In claim 25, line 5, delete "appearing at the Laroia precoder input" and insert "by the Laroia precoder".

In claim 25, line 9, delete "the remaining" and insert "remaining".

In claim 26, line 4, delete "a turbo" and insert "a receiver turbo".

In claim 26, line 4, delete "a constellation" and insert "a receiver constellation".

In claim 29, line 4, delete "the transmitter constellation shaping elements" and insert "the constellation shaping elements of the transmitter".

In claim 30, line 2, delete "a transmission" and insert "the transmission".

In claim 38, it appears that claim should depend on claim 28.

In claim 40, line 3, delete "the remaining" and insert "remaining".

In claim 40, lines 3-4, delete "transmitter TTCM encoder" and insert "TTCM encoder of the transmitter".

In claim 41, line 2, delete "transmitter constellation shaping elements" and insert "constellation shaping elements of the transmitter".

In claim 41, line 6, delete "a number N of transmit symbols" and insert "N symbols".

In claim 42, line 2, delete "N receive symbols" and insert "N symbols".

In claim 43, line 3, delete "the N transmit signals" and insert "the N symbols".

In claim 45, line 6, delete "the partitioned" and insert "a partitioned".

In claim 46, line 2, delete "the step of computing" and insert "a step of computing".

In claim 46, line 3, delete "the likelihood" and insert "a likelihood".

In claim 46, line 3, delete "the ratio" and insert "a ratio".

In claim 46, line 3, delete "the probability" and insert "a probability".

In claim 47, line 2, delete "the step of preparing" and insert "a step of preparing".

Claims 12,13,17,27,28,31-37,39,44 and 48 directly or indirectly depend on claim 1,26 or 45. Appropriate correction is required.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-4,12-17,26-28,38 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Eyuboglu (cited no.CE in the IDS) in view of Gelblum et al. USP, 6,088,387 (Gelblum).

Regarding claims 1, 26 and 28, Eyuboglu teaches a method and apparatus of binary coded data communication, the method comprising the steps of providing a transmitter having a trellis coded modulator (TCM) encoder and constellation shaping elements, a receiver having a receiver turbo decoder, and receiver constellation shaping elements (see Fig.6); and generating a plurality of signal points in response to a partitioned binary coded symbol sequence that is processed via the TCM encoder and constellation shaping elements. (see Fig.5 and note p.303-305)

However, Eyuboglu does not teach wherein the trellis coded modulator is a turbo trellis coded modulator.

Gelblum teaches combining turbo codes with a trellis code modulation and discloses a turbo-trellis code modulation (TTCM) (see Fig.1). And further teaches that TTCM achieves low bit error rate (BER). (note col.1, line 13 – col.2, line 62) Therefore, it would have been obvious to one skilled in the art at the time of the invention to modify Eyuboglu's TCM with TTCM for the purpose of achieving a higher BER, and furthermore, TCM and TTCM belong to same family of trellis modulation.

Regarding claim 45, Eyuboglu teaches a method and apparatus of binary coded data communication, the method comprising the steps of providing a transmitter having a trellis coded modulator (TCM) encoder and constellation shaping elements, a receiver having a receiver turbo decoder, and receiver constellation shaping elements (see Fig.6); and generating a plurality of signal points in response to a partitioned binary coded symbol sequence that is processed via the TCM encoder and constellation shaping elements. (see Fig.5 and note p.303-305) Eyuboglu further teaches providing a receiver having a turbo decoder and constellation shaping elements, and processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements to recover the partitioned symbol sequence. (see Fig.6 and note p.304 having a nonuniform probability distribution)

However, Eyuboglu does not teach wherein the trellis coded modulator is a turbo trellis coded modulator. Gelblum teaches combining turbo codes with a trellis code modulation and discloses a turbo-trellis code modulation (TTCM) (see Fig.1). And further teaches that TTCM achieves low bit error rate (BER). (note col.1, line 13 – col.2, line 62) Therefore, it would have been obvious to one skilled in the art at the time of the invention to modify Eyuboglu's TCM with TTCM for the purpose of achieving a higher BER, and furthermore, TCM and TTCM belong to same family of trellis modulation.



Regarding claim 2, Eyuboglu in view of Gelblum teach all subject matter claimed, as applied to claim 1. Eyuboglu further teaches wherein the step of generating a plurality of signal points in response to a partitioned binary coded symbol sequence that is processed via the TTCM encoder and constellation shaping elements comprises the step of generating a signal constellation having square shaping regions (see Fig.4) capable of use in association with trellis shaping that is compatible with rate  $k_c/n_c$  TTCM, such that a binary  $k_c$  -tuple portion of a desired symbol sequence can be processed via the TTCM encoder for a rate  $k_c/n_c$  TTCM code to generate a  $n_c$  -tuple.

Regarding claim 3, Eyuboglu in view of Gelblum teach all subject matter claimed, as applied to claim 1. Eyuboglu further teaches wherein the step of generating a plurality of signal points in response to a partitioned binary coded symbol sequence that is processed via the TTCM encoder and constellation spherical elements comprises the step of generating a signal constellation having square shaping regions capable of use in association with trellis shaping that is compatible with rate  $k_c/n_c$  TTCM, such that a binary  $k_c$  -tuple portion of a desired symbol sequence can be processed via the TTCM encoder for a rate  $k_c/n_c$  TTCM code to generate a  $n_c$  -tuple. (see Fig.14 and note p.311)

Regarding claim 4, Eyuboglu in view of Gelblum teach all subject matter claimed, as applied to claim 1. Eyuboglu further teaches wherein the step of providing a transmitter having a turbo trellis coded modulator (TTCM) encoder and constellation shaping elements comprises the step of providing trellis precoding elements and TH-precoding elements capable of use with non-square constellations. (see Fig.8 and note p.306-308)

Regarding claim 12, Eyuboglu in view of Gelblum teach all subject matter claimed, as applied to claim 1. Eyuboglu further teaches the step of processing the plurality of signal points via a trellis precoder to generate a coded symbol sequence. (see Fig.7 and 8)

Regarding claims 13,14 and 27, Eyuboglu in view of Gelblum teach all subject matter claimed, as applied to claim 12 or 26. Eyuboglu further teaches providing a receiver having a turbo decoder and constellation shaping elements, and processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements to recover the partitioned symbol sequence. (see Fig.6 and note p.304 having a nonuniform probability distribution)

Regarding claim 15, Eyuboglu in view of Gelblum teach all subject matter claimed, as applied to claim 12. Eyuboglu further teaches wherein the step of processing the plurality of signal points via the receiver turbo decoder and the

receiver constellation shaping elements comprises the steps of: folding the coded symbol sequence to generate a folded constellation (see Folding in Fig.9); processing the folded constellation via the turbo decoder to generate estimated signal points (see Decoder in Fig.9); and processing the estimated signal points via an inverse mapper to generate an estimated binary  $k_c$  -tuple part of the desired bit sequence according to the rate  $k_c/n_c$  TTCM code, an estimated uncoded binary  $n_u$  -tuple part of the desired symbol sequence, and an estimated binary  $r_s$  -tuple part of the desired bit sequence according to the rate  $k_s/n_s$  convolutional shaping code. (see Fig.6)

Regarding claims 16 and 17, Eyuboglu in view of Gelblum teach all subject matter claimed, as applied to claim 15. Eyuboglu further teaches wherein the step of processing the plurality of signal points via the receiver turbo decoder and the receiver constellation shaping elements further comprises the step of processing the estimated binary  $k_c$  -tuple part of the desired bit sequence according to the rate  $k_c/n_c$  TTCM code to recover  $k$  bits based on  $n$  bits and to generate an estimated binary  $k_c$  -tuple part of the desired symbol sequence, and the step of processing the estimated binary  $r_s$  -tuple part of the desired bit sequence according to the rate  $k_s/n_s$  convolutional shaping code to generate an estimated syndrome  $r_s$  -tuple part of the desired symbol sequence. (see Fig.6)

Regarding claim 38, Eyuboglu in view of Gelblum teach all subject matter claimed, as applied to claim 28. Eyuboglu further teaches wherein the trellis precoder comprises a Tomlinson-Harashima precoder. (note p.305)

4. Claims 5 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Eyuboglu (cited no.CE in the IDS) in view of Gelblum et al. USP, 6,088,387 (Gelblum) and Khandani (Shaping of Multi-dimensional Signal Constellations Using a Lookup Table), IEEE.

Regarding claims 5 and 39, Eyuboglu in view of Gelblum teach all subject matter claimed, as applied to claim 1 or 26. Eyuboglu in view of Gelblum further teaches wherein the step of generating a plurality of signal points in response to a partitioned binary coded symbol sequence that is processes via the TTCM encoder and constellation shaping elements, however, do not explicitly teach partitioning a signal constellation into cosets and shells in compliance with shell mapping and TTCM. Khandani teaches teach partitioning a signal constellation into cosets and shells in compliance with shell mapping and TCM. (see Fig.1 and note p.0927-0928) Therefore, it would have been obvious to one skilled in the art at the time of the invention to modify Eyuboglu's system by replacing Eyuboglu's constellation shaping elements with a shell mapper of Khandani for the purpose of increasing average energy, as taught by Khandani (note p.0928).

***Allowable Subject Matter***

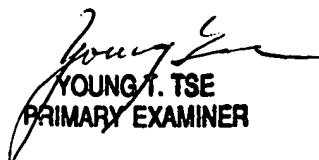
5. Claims 6-11, 18-25, 29-37, 40-44 and 46-48 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, and overcome the claim objections.
6. The following is a statement of reasons for the indication of allowable subject matter:  
  
Present application discloses a turbo trellis coded modulator combined with constellation shaping elements. Closest prior arts, Eyubolgu and Gelblum, teach all subject matter claimed. However, prior art do not teach wherein the transmitter constellation shaping elements comprise a shaping code decoder as recited.  
  
Further, prior art do not teach the partitioned symbol sequence having three parts with the limitations, as recited.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sam Ahn whose telephone number is (571) 272-3044. The examiner can normally be reached on Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jay Patel can be reached on (571) 272-2988. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Sam K. Ahn  
10/18/04

  
YOUNG T. TSE  
PRIMARY EXAMINER